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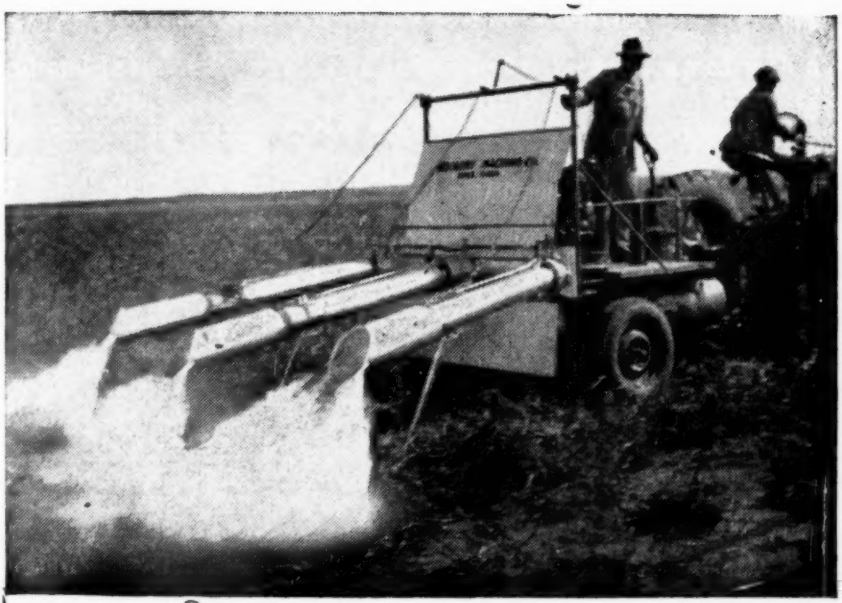

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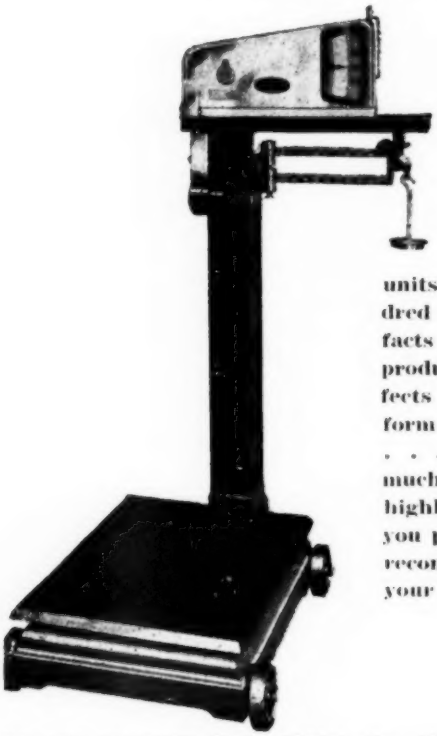

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NEW BLIGHT-RESISTANT VARIETIES

DONALD REDDICK AND L. C. PETERSON

Cornell University, Ithaca, N. Y.

The primary purpose of this article is to record in a readily accessible place technical descriptions of hybrids which have emerged from a program of work designed to develop new varieties which are immune to the blight caused by *Phytophthora infestans*. The general methods employed have been described in a previous issue of this *Journal* (20: 118) and need not be repeated here. Likewise, details of method are to be found in a subsequent issue of the Journal (22: 357) in connection with a description of the variety Empire. Particular attention is directed to the discussion in the latter paper under the heading "stability of blight-proof character."

The method of introduction of these varieties is partly one of necessity and partly one of design. "Necessity" is based on the well established fact that there are areas in New York where it is difficult or quite impossible to produce seed potatoes because of the high incidence of virus diseases. While it may never have been demonstrated conclusively there is an impression generally extant that areas in the immediate vicinity of experiment stations are "hot beds of infection" for all kinds of plant diseases. In any case, it is very difficult to keep stocks of potatoes free from virus diseases in the environs of Ithaca. As soon as a hybrid gives some indication of possessing commercial value it is taken to areas in the state where seed stock is produced regularly and in general to the farms of growers who have a consistent record of year after year "certification." Much sorting of hybrids continues on

these farms with eventual yield testing of outstanding sorts. Growers are given title to the stock that is brought to their farms. This is "design." It establishes an interest that is most helpful in making a final decision about naming a variety. The grower contributes his knowledge of the commercial aspects involved and having seen the variety emerge he is in a better position than any one else to get the variety into commercial production in the shortest possible time. There is no evidence at all, and none was expected, that any of the collaborators have given a thought to the temporary monopoly they may enjoy. In some instances monopoly actually exists at the present time because some hybrids may be dropped in one locality and not in another.

In some instances the decision to drop a particular hybrid in a specific locality may have been nothing more than a mistake; but in other cases it was pretty certainly a matter of regional adaptation; and in still other cases the farm economy of the community has been a factor. It will be noted in the case of some varieties described here that little is known of their adaptation outside the restricted area in which they emerged. The varieties can be grown to advantage in these restricted areas and they will be grown there until something better appears. They will, therefore, get a local name or names. It has seemed better to introduce such varieties under a single name and thus make them identifiable both locally and in a wider sphere in case any of them prove to be useful.

Empire

Released for increase, January 1945.
Described in Amer. Potato Jour. 22: 357-362. 1945.

Empire was tested again on the south fork of Long Island in 1946 and in the absence of a bridging variety developed foliage blight late in the season. Unsprayed Green Mountains in the same plot had been dead for over a month with blight. Tuber rot was found on Empire as well as on Green Mountain. It is known that the tubers of Empire and of many of the hybrids have little or no resistance to blight. It is not known whether the tubers of Empire became infected from Green Mountain plants or from its own blighted foliage but in any event the organism has emerged from such tubers in virulent condition. It would appear that the use of Empire should be discouraged. While it is possible to discourage its use there is no way now to suppress the variety. It is in the hands of the general public and will be used or dropped on the basis of other characters than resistance to blight. In the seed-producing areas the growing season is shorter than it is on Long Island and blight usually becomes prevalent much later in the season. Either

frost or a chemical vine killer would terminate growth before immunity breakdown, hence no infection. This is, of course, too tenuous a thread on which to hang one's hope of a permanent suppression of potato blight but it is a stopgap which can be employed with caution until such time as a substitute variety can be selected. The most serious aspect of the situation appears to be that Empire may be the means of raising the level of virulence of *P. infestans* so that other varieties already "released" will not continue to be immune.

It is relatively easy now to produce thousands of hybrid seedlings which give an immune reaction when inoculated with *P. infestans*. It is easy to see that among the plants lying below the threshold of infection there are varying degrees of resistance. It is therefore inferred that such differences occur among the plants lying above that line and breeding behavior of some such plants certainly supports the inference.

In the cool and moist season of 1946, Empire has responded to the favorable conditions and has given higher than average yields just as was true for standard varieties. The production of tubers of too great size is a definite fault of the variety. The fault can be overcome to a considerable extent by planting the seedpieces 7 or 8 inches apart in the row. Also, from the commercial standpoint the tubers have too few eyes for machine cutting and this results in missing hills and consequent production of oversize tubers.

Placid

Released for increase at Buffalo meeting of Empire State Potato Club. January 1946.

Origin

The variety Placid is one of the many hybrids produced in the past several years in an endeavor to develop a blight-proof variety for commercial production. The fantastic chart of parentage illustrates throughout the gropings of the earlier efforts and to some extent the often repeated remark that in the end one takes what he can get. The name is taken from a well known lake in the Adirondacks where the variety first attracted attention in the variety tests conducted on the farms of the Lake Placid Club.

Description of Placid

Habit. Plants emerge as several stalks which remain erect until they are 40-60 cm. tall after which they spread and become large and dense with much growth of axillary shoots; stems sturdy, thick, green throughout, solid except near tips where there may be a cavity 1-2

Placid
(DAC/1)
ABX/6
Alma
DL/1 ♂
860 ♂
(672/19
Smooth Rural
178 (demissum) ♂
AFY/5 ♂
F2<JV/7
selfed
822
483
289 (Imperia) ♂
851 (Katahdin) ♂
400 F2<277
304 (Silhonetto)
178 (demissum)
167 (Fendleri) ♂

mm. in diameter, very scant white hairs; wings inconspicuous, green, knife edge; nodes not swollen, green; internodes short, 3-6 cm.; stipules small, 10-15 mm., short, clasping; leaves compact, short, 16-24 cm., dark green throughout; petioles short 3-4 cm., sparse white hairs; midrib green throughout; leaflets usually 3 pairs, elliptic to oval, acuminate tip, moderately rugose, scant short white hairs, mean length of blade 74.98 ± .959 mm., mean width 45.33 ± .495 mm., index 60.714 ± .41; folioles fairly large, leaf-like, sessile, usually one pair between each pair of leaflets, often also an additional pair of tiny ones between some or all of the pairs of leaflets.

Inflorescence. Short 6-10 cm., medium branching, 3-8 flowers; peduncles green, flattened, sparse fairly long white hairs; pedicle extra long 2.5-3 cm., green, paler green distad of the articulation, sparse long white hairs more abundant distad of articulation; articulation not swollen, evident only by a ring of hairs and the change in color of pedicle; calyx pale green, fairly long subulate teeth, sparse white pubescence; corolla rotate, lavender, the sinus a mere notch, teeth short acuminate, white inside but whitish externally with brownish, pyramidal shields on each lobe; stamens rather short, bright orange, locules inconspicuous; pollen moderately fertile; style short, barely exceeding the anthers, white, cylindric; stigma capitate, greenish, small, globular; seedball globular, pale green with a few white submerged spots at stylar end; seeds nearly white, abundant.

Tuber. Weight and measurements based on 100-tuber sample. Mean weight 279.4 ± 8.136 gms.; mean length 101.95 ± 1.386 mm.; mean width 80.45 ± 2.596 mm.; mean thickness 57.97 ± .636 mm.; index (width to length) 79.886 ± .964; index (thickness to length) 57.265 ± .822; index (width to thickness) 72.393 ± .698; sprout not colored in dark; sprout color in light vinaceous drab; skin warm buff (R); eyes, fleet; eyebrow, inconspicuous; flesh white; boiled tuber white, fine grain, mashes down smooth, moderately mealy, good flavor; maturity midseason, matures with Katahdin; storage, little or no apical dominance; rest period, breaks early.

Characteristics

Placid, as grown in the field, gives a very favorable impression at all times. Several stalks emerge promptly and because of the compact growth cover the ground early. The stems approximate determinate growth and remain erect until maximum height is attained. Thereafter they go down and may become nearly or quite prostrate but the profuse development of axillary shoots still gives the impression of an upright plant.

The variety has been subjected to both hot (90° F.) and to dry weather. It has exhibited some resistance to both conditions. A combination of these conditions causes a physiological roll of the leaflets which is not particularly confusing because most or all of the leaves roll. They do not have the hard brittle "feel" of the leafroll caused by virus.

The set of tubers, the growth period and maturity date correspond rather closely with the variety Katahdin. The tubers are not so smooth and bright as Katahdin. They do not hold their shape as well as Katahdin in years of drought followed by excess moisture.

Placid pleases the growers because there are plenty of well distributed eyes and particularly because there is almost total lack of apical dominance so that every eye produces a good strong sprout.

Cooking quality has ranged from moist and slightly mealy to dry and mealy, and from good to excellent flavor.

Reaction to Diseases

Repeated inoculation of vigorously growing plants with *P. infestans* (Cornell Lab. culture virulent for the hybrid AAB-2) has resulted in an immune reaction. Infection has been observed with inoculation in greenhouse and field apparently from blighted Empire. Infection by means of senescent leaves has been established in greenhouse tests.

Early blight (*Alternaria solani*) was noted one year by W. R. Mills at State College, Pa.

Inoculation with virus X by means of a grafted scion from Rural New Yorker gave no reaction. Placid is considered passive but its carrying capacity of acronecrosis is unknown.

When inoculated by grafting with a "severe" virus X taken from Katahdin a brilliant mosaic develops.

Inoculation with virus Y by graft inoculation results in a very indefinite mosaic. In subsequent clonal generations the mosaic is indefinite or not discernible at all. Immediately following 48 hours of continuous rainy weather diseased units in a tuber-unit plot were easily detected by their yellowish color. This method is not effective on a warm, dry day. The disease causes a definite dwarfing of plants, a symptom which is only moderately useful in eliminating diseased plants. Presumably the yield of tubers is affected adversely but how great this may be is not known. The presence of even a trace of the disease in the variety is most undesirable because of the ease with which aphids can pick up virus Y and communicate it to susceptible varieties. In the greenhouse the disease can be detected best in January and February under natural light when the mosaic pattern ranges from indefinite to

clearly discernible. The leaflets show considerable rugosity, and the margins of unfolding leaflets are wavy.

Placid is susceptible to common scab and to leafroll but it is not known how readily it picks up the latter disease.

Adaptation

In New York, Placid appears to be the most widely adapted of any of the hybrids thus far tested. It is early enough to mature in the short season of the Adirondack area and in the long season of Long Island. It has been grown on several different types of soil and has given satisfactory yields on all of them. It withstood an outbreak of blight near Maracay, state of Aragua, Venezuela, 480 m. elevation, about 11° n. latitude but was grown in too limited amount to state definitely that it could be produced there economically.

Dissemination

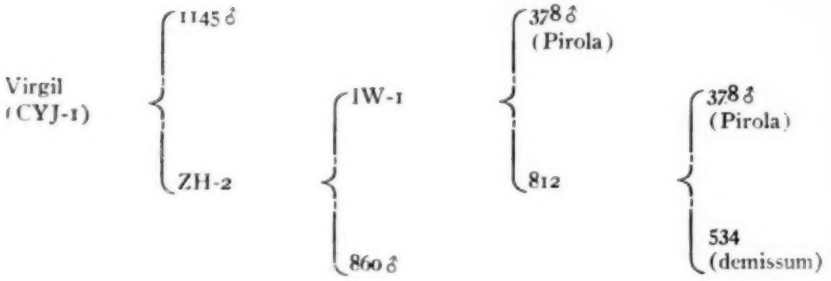
All of the stock of Placid is in the hands of seed producers and is being increased by them just as rapidly as possible. All of the available supply of the 1946 crop was engaged on the day the variety was released. It is, therefore, useless to make known the names of growers until the end of the 1947 season. For some unknown reason, Placid stands in greatest favor with seed growers. Many of them have seen the experimental plots, most of them have seen exhibition tubers, and some have studied yield data although in no case do these data cover more than 3 years of test.

Virgil

Released for increase at Buffalo meeting of Empire State Potato Club. January 1946.

Origin

Virgil is a plant in third backcross stage from a collection of *Solanum demissum* made at El Desierto, D. F., Mexico in 1930. As can be seen from the diagram it represents straight backcrossing and is the best method known for prompt results. The first cross was made May 28, 1931, and yielded 7 seeds. The first backcross made in June 1932; second backcross in May 1934; third backcross, May 1939. The hybrid ZH-2 was non-receptive in 1938 but in 1939, 6 of 12 trials yielded seeds and as the plants were considered much too late in maturity date they were dropped. In the third backcross Krantz' seedling 15-2 conferred much needed earliness.



Description of Virgil

Habit. Plants emerge as several sturdy erect stalks which become 50-60 c. tall, thereafter spreading but maintaining a semi-erect position; stems green throughout, thick, fleshy, pubescence very sparse consisting of short curved white hairs; wings not prominent, wavy, green throughout; nodes slightly thickened, not colored; internodes short 3.5 to 6 cm., hollow, the tubular cavity about 3 mm. in diameter; stipules small, reniform, clasping; leaves short, 17-23 cm. long, compact; petioles short, 4-5 cm. long, faint vinaceous coloration in channel which fades out in midrib but is accentuated at junction of leaflets and extends a short distance in the midvein; leaflets mostly 4 pairs, sessile, short stalked to 8 mm., pale green with an oily sheen, extremely rugose from the beginning, flat elliptic with acuminate tip and undulating margin, with age, terminal leaflets roll slightly and develop vinaceous coloration on under side at the tip, pubescence very inconspicuous existing as very short white bristles. Mean length 62 ± .5 mm.; mean breadth 37.1 ± .34 mm.; leaf index 59.97 ± .43; folioles numerous, leaf-like, 1 pair at base and 1 pair between each pair of leaflets with usually an additional pair or 1 or 3 small sessile ones.

Inflorescence. Erect, short 9-10 cm., sparsely branched, 10-12 flowers in the cluster; peduncle green throughout, slightly flattened, sparse very short white hairs; pedicle fairly long 2 to 3 cm., green, sparse short fine hairs; articulation a slightly swollen vinaceous ring; calyx pale green, short, short acuminate tip; corolla large, diameter from tip of lobe to sinus opposite 26-32 mm., lavender, rotate, short acuminate teeth, very shallow sinus, becoming strongly reflexed; stamens orange, exposed only after corolla opens, pore present, inconspicuous, evident as two vinaceous spots in dehisced anthers; pollen moderately fertile; style long, cylindric, extruded before flower opens; stigma small green capitate; seedballs globular, dark green, immaculate.

Tubers. Mean weight 295.07 ± 7.571 gms.; mean length 104.13

± 1.208 mm; mean width 84.48 ± .767 mm.; mean thickness 57.44 ± .661 mm.; index (width to length) 82.037 ± .888; index (thickness to length) 55.954 ± .861; index (width to thickness) 68.177 ± .785; sprout color in dark, uncolored except tips of terminal and lateral leafscales rhodonite pink (R); sprout color in light, uncolored except tips are drab (R); maturity slightly later than Placid but in general about like Katahdin.

Characteristics

Virgil, like Placid, presents a fine appearance in the field from the beginning. It continues nearly erect throughout the season and approximates a determinate type of growth. This type of growth makes for ease in applying insecticides. The strongly rugose foliage, a characteristic inherited from Krantz' seedling 41-2-10-1, makes the variety easy to identify. The pale greenness of foliage is not paler than Green Mountain. Heat and drought tolerance, likewise originating with Krantz' seedling, is superior to Placid and approximates or equals that of Empire. Physiological leafroll has not been recorded in the years 1941-1946.

The shape of the tuber is not outstandingly attractive and the eyes are deeper than one could wish. Cooking quality, so far as it has been tested, is perhaps the best of any of the varieties here described. Growth cracks or knobs have not been noted in the variety. The number and distribution of eyes and lack of strong apical dominance are characters which appeal to the grower.

Reaction to Disease

There are certain indications that Virgil lies farther over the threshhold of blight incidence than does Empire or Placid even though some blight on green leaves was encountered on Long Island in 1946. In any event the perpetuation of a virulent form by perennation in tubers is unlikely because of maturity date. The variety is susceptible to rugose mosaic and reacts typically—severe vein and stem streak, acropetal necrosis, severe mosaic in subsequent clonal generations.

Virgil is, at least, passive to acronecrosis (virus X) as determined by grafting on a scion of Green Mountain, a carrier variety. Leafroll resistance has not been determined other than to note that leafroll has been recorded for only two plants in the years 1940 to 1946. The variety is susceptible to common scab.

Adaptation

Virgil has been widely tested in New York. It is at its best in the central plateau area and gets its name from a village in southern Cort-

land County. In some areas of the state it is exceeded by Placid and very significantly so in the Adirondack area. It is very well adapted to the dairy country of central New York where acreage on individual farms is small and where potatoes are for the most part strictly a secondary crop.

Dissemination

As in all other cases, the entire stock of Virgil is in the hands of seed growers. They are increasing stock as rapidly as possible and have sold almost exclusively to other seed producers so that there should be a moderate supply available to the general public in the autumn of 1947.

Ashworth

Released for increase at Buffalo meeting of Empire State Potato Club, January 1946.

Origin

The chart of parentage for Ashworth illustrates again the gropings of early efforts in the production of blight-proof varieties. No significance, whatsoever, is to be attached to the method employed. The immune parent is *Solanum demissum* (#178) the original seedling plants of which were contributed by Fred L. Ashworth, Heuvelton, N. Y., in the spring of 1928. The variety is named for Mr. Ashworth a self-educated farmer and philosopher whose avocation is a search for frost tolerant plants of economic importance. Mr. Ashworth not only supplied seedlings from which it was determined that the species is immune but has also been of much assistance in testing various seedlings. He has very mild interest in the commercialization of his finds.

Some elucidation of parents indicated in the chart is needed. *S. maglia* (180) is not a good species but rather a heterozygous variety indigenous on the Island of Chiloe. Silhonetto (Sylvan X Hindenburg) is a variety obtained from P. T. Knappe in Esthonia in 1929. No. 421-2 (U.S.D.A., S. 43572 X S. 42667) is an unnamed seedling which was selected from a lot of plants grown from seeds contributed by C. F. Clark. The plant produced an abundance of fertile pollen and was particularly useful because it was relatively early in maturity. Nos. 349 and 860 are unnamed seedlings obtained from F. A. Krantz under the numbers 75.25-5-7 (in 1936 Krantz renumbered this 11-5-9) and 41-2-10-1.

Description of Ashworth

Habit. Short spreading plants 50-60 cm. tall, determinate; stems sturdy, angular, thick, stiff, green throughout (Ashworth farm) or with pale vinaceous coloration at base (Carpenter farm), studded with

Ashworth
(ECU-1)
CBP-1<BHS-10
(F2)
860 ♂
(41-2-10-1)
AGC-2<JY-6
(F2)
349 ♂
(Krantz
11-5-9)
826-1
421 ♂
454
364 ♂
Silhonetto
229
Maglia ♂
(180)
demissum
(178)
AQF-4 ♂
VG-5<JZ-7
(F2)
826-1
Katahdin ♂
Katahdin ♂
364 Silhonetto ♂
421-2 ♂
454
Maglia ♂
229
demissum

very sparse short white hairs; wings inconspicuous or none, green; nodes not swollen, not colored; internodes short, 4-6 cm.; stipules leaf-like, clasping, large, sessile, especially if axillary shoot has pushed; leaves large, open 23-30 cm. long, dark green throughout; petioles 5-9 cm. long, channel shallow, green; leaflets 3 or 4 pairs, dark green, elliptic, somewhat rugose, acuminate tips, short (4-6 mm.) stalked; mean length 74.89 ± .86 mm.; mean width 45.64 ± .58 mm.; leaf index 61.0 ± .14; folioles usually lacking.

Inflorescence. Tall, erect, medium branching, 8-12 flowers in cluster, no leafy bract; peduncle nearly cylindric, 9-10 cm., fairly dense very short white pubescence; pedicle long, green, cylindric, pubescence as on peduncle; articulation inconspicuous, not colored; calyx lobes green, awl-like, sparse short white hairs; corolla white with pale lavender shield on inside of each lobe, rotate, shallow cleft, sharply acuminate teeth; anthers yellow to orange, short, pores distinct, but not marked by color; pollen scant to none, occasionally fertile; style long, cylindric, extruded before corolla opens; stigma small, globular.

Tuber. Mean weight 265.97 ± 6.973 gms.; mean length 90.18 ± 1.117 mm.; mean width 90.09 ± 1.009 mm.; mean thickness 55.26 ± .6 mm.; index (width to length) 100.636 ± 1.326; index (thickness to length) 61.886 ± .817; index (width to thickness) 61.689 ± .701; sprout uncolored in dark or light; skin warm buff (R); eyes, fleet; eyebrows, inconspicuous; flesh, white; maturity, slightly earlier than Katahdin.

Characteristics

Ashworth is an open, determinate, erect plant and remains erect until mature. The variety has been subjected to both hot and dry weather. With heat alone the leaflets show physiological roll and crinkling of leaflets. Terminal leaflets, particularly ones that roll, sunburn and show purplish coloration on the exposed lower side. In 1943 a year of extreme drought at State College, Pa., W. R. Mills found that despite appearance Ashworth was seventh in total yield in a lot of 72 hybrids and fourth in yield of marketable tubers.

The tubers approximate Katahdin in size, shape and appearance but the large tubers tend to be rough and the eyes at the bud end are rather deep.

The cooking quality is equal to or superior to Katahdin. In several cases the variety has been rated extra good, dry and mealy.

Reaction to Diseases

Ashworth has been subjected to natural spread of blight in the

field and has never shown any disease.[1] It has been inoculated with a virulent culture (Cornell Lab. culture infective on hybrid AAB/2) of the organism in the greenhouse and gave an immune reaction. Its behavior upon inoculation of senescent leaves is not known.

The variety is passive to virus X as indicated by negative reaction with a grafted scion of Russet Rural, a carrier of virus X, and also passive to virus Y by graft inoculation. It is susceptible to leafroll.

Adaptation

The variety has been developed in St. Lawrence County, New York, an area where potato production is strictly secondary to the dairy industry. It matures satisfactorily in the short growing season of the area and its apparent immunity to blight makes it particularly useful there because very few farmers feel justified in owning suitable equipment for satisfactory blight control by spraying the vines. Tests in other parts of the state were interrupted early by the incidence of leafroll in the stocks, but the limited tests made recently suggest that the variety may have wider usefulness than is now known. The ability to produce a crop under extremely dry conditions, as indicated by the trial in Pennsylvania in 1943, is a factor of considerable importance in many places.

Dissemination

Ashworth is available in extremely limited amounts at present and will be increased rather cautiously until more is known about the adaptability of the variety and particularly until something more is known about a sib which may eventually prove superior to it.

CHENANGO

Released for increase at the Buffalo meeting of Empire State Potato Club, January 1946.

Origin

Chenango is another variety developed at the Cornell University Agricultural Experiment Station in an attempt to effect permanent control of potato blight by the use of the natural immunity of *Solanum demissum*. As in many cases the pedigree shown in the chart has nothing to commend it. The original cross *demissum* x *fendleri* was made Aug. 1, 1928. This interspecific hybrid was made with the original intention of determining the mode of inheritance of blight immunity. All of the plants in the second generation (family 400) were immunes and

[1]On Sept. 15, 1947 blight was found on the last few dying leaves of Ashworth.

all of them had exactly the appearance of the female parent, *S. demissum*, so that while certain facts were ascertained they did not give an answer to the original question. So far as is known nothing was lost or gained by using a plant of the family 400 over the use of the original *S. demissum* in making the cross with Silhonetto except that the flowers were available in that case and were not available in the case of No. 178 or any other specimen of *S. demissum*. The hybrid, JV-9, received some consideration as a possible commercial variety but was eventually discarded because of purple skin-color. The selfing of JV-9 and growth of progeny (VA family) was done primarily to determine whether there would be a reversion to wild type after a second backcross. The reversion did not occur in this instance. Selection No. 3 being a self-fertile plant was tested to find out whether an immune hybrid in this state of dilution from the wild immune could be used as a male parent and thus bring into the program many of the commercial varieties most of which had proved non-receptive to the pollen of *S. demissum*. One-third of the trials were successful thus helping to decide the question favorably but the use of "Choquefrit" from LaPaz was essentially fortuitous in that flowers happened to be available for the purpose on June 1, 1935. AZT-2 was a large late plant, as might have been anticipated, exhibiting tolerance for drought and for frost, self-fertile; but the skin of the tubers was variegated, mostly purple but with clear white areas about each eye. BXS-1 was a self-fertile plant, which set far too many tubers on longish stolons but the tubers had white skins. In the light of present knowledge, it was used prematurely but doubtless was used because of its fertile pollen. There is nothing in the records up to this point to suggest that an "earliness" factor was present. The earliness of Chenango seemingly must have come from the other side of the family even though "1097" (U.S.D.A., 46110) is a main-crop variety at Ithaca. According to E. S. Schultz the variety (46110) is nearly passive to virus Y.

The pedigree of Chenango illustrates exceptionally well some of the exploratory probings that have been made since 1928 and the detailed recital of this case history will make it unnecessary to explain in such detail the pedigree charts of other varieties for which descriptions are now being constructed.

The name is taken from the name of the county of New York in which the variety was developed. It has no connection whatsoever with the old variety Black Chenango.

Description of Chenango

Habit. Plant emerges as one to several weak stalks, becomes 35

Chenango (CUI-2)
1097 (U.S. 46110)
AQT/2
BXS/1 ♂
860 ♂ (Krantz' 41-2-10-1)
M228 (F.P.I. 100, 743) "Choquefrit" LaPaz
VA/3 ♂ (F2) <JV/9 selfed
822
851 ♂ (Kataluin)
483
289 ♂ (Imperial)
400 < 277 F2 selfed
178 demissum
167 ♂ (Fendleri)
364 Silhonetto)

to 45 cm. tall, then spreads and becomes nearly prostrate, fills by the abundant development of axillary shoots; stems straight, angular, medium thick, green throughout, very scant short white hairs; wings inconspicuous disappearing distally, green, knife edge, narrow; nodes slightly swollen, green; internodes short, 3-5 cm., solid; stipules a petiolate pair, small, short, clasping; leaves light green, large, short, 20-22 cm., open; petioles fairly long, 5-7 cm., channel shallow, midvein green; leaflets usually 4 pairs, dark green, smooth on short petiolules, 4-10 mm., elliptic, with acuminate tips, scant white, very short pubescence, mean length of blade 59.7 ± .7 mm.; mean width 37.2 ± .42 mm.; leaf index 62.4 ± .26; folioles usually present but varying from none at all to 1 or 2 pairs, or 2 pairs or even more between each pair of leaflets and occasionally one pair on the petiolules.

Inflorescence. Short, 8-12 cm., medium branching, 10-12 flowers; peduncle short 6-8 cm., green, flattened, scant white hairs; articulation very inconspicuous, colorless; calyx green, subulate tips, scant short white hairs; corolla white, rotate with deep clefts and short teeth; stamens small, short, lemon yellow; pore a faint orange line showing only with age; pollen none; style twice as long as stamen, pale straw color, cylindric; stigma globular or inconspicuously 2-lobed.

Tuber. Medium elliptic to roundish with blunt ends, rather thick; mean weight 240.43 ± 6.909 gms.; mean length 91.10 ± 1.162 mm.; mean width 77.91 ± .731 mm.; mean thickness 56.36 ± .629 mm.; index (width to length) 85.488 ± 1.396; index (thickness to length) 61.21 ± .861; index (width to thickness) 71.392 ± .751; sprout uncolored in the dark; sprout color in light, light vinaceous drab (R); skin cream buff (R), smooth; eyes shallow, same color as skin; eyebrows moderately prominent, curved; flesh white; boiled tuber white, slightly mealy, good flavor; maturity early.

Characteristics

The outstanding characteristic of Chenango is its early maturity in which it is comparable with Cobbler and Chippewa. The stems are weak and the plants become prostrate. Both heat and drought cause a physiological leafroll. There is a strong tendency to set too many tubers with the result that in dry seasons too few tubers reach commercial size. The tubers are much smoother than Cobbler and approximate Chippewa in skin and eye characters.

Reaction to Disease

Chenango is immune to late blight in greenhouse tests (Cornell Lab. culture virulent on A.AB-2) and in field plots. Even if infection can

be induced as in the case of Empire previously noted there is relatively little chance that the variety would become infected because the plants mature before late blight commonly becomes prevalent in New York State.

A scion of Green Mountain, carrying virus X, was set on Chenango but the axillary shoots which pushed from the stock appeared perfectly healthy. The variety is considered passive, at least, to acronecrosis. The variety is susceptible to leafroll and to virus Y. Common scab has not been observed on the tubers but no tests for scab resistance have been made.

Adaptation

In New York, the tests so far conducted indicate that Chenango will be restricted to the area in which it was developed. Dr. A. J. Pratt has grown the variety on an acre basis in Chenango County and his neighbors there are growing it. Doctor Pratt, through his work with 4-H clubs, will presently have extensive data on adaptation.

The variety is suited to the agricultural conditions of the area in which it was developed and will be grown locally, at least, until something better is found. One name for the variety seems better than the half dozen names that inevitably would spring up even in the confines of a single county.

Dissemination

In accordance with practice the surplus stock of Chenango is in the hands of collaborators. In this instance and for the planting season of 1947 the one collaborator who has appreciable surplus is Doctor A. J. Pratt.

Other Varieties

At the Rochester meeting of the Empire State Potato Club, January 1947 other varieties were released for increase. These include Essex (DAB-3), an early maturing sort, Madison (DUY-2), a second early, Snowdrift (DDD-10), an early, Cortland (DFC-1) a main-crop variety, Fillmore (CRH-3) and Harford (CSF-11) both late varieties. Several other hybrids are making a substantial record to date and will be disposed of one way or another within one or two years more.

The authors have no compunction about introducing new varieties. The "trade" is inclined to favor a few standard varieties and seed growers are more strongly so inclined because it reduces the danger of varietal mixture. Nevertheless, there are dozens of varieties of potatoes grown in New York in the so-called non-commercial areas and some of them are as old as Early Rose while still others, like Lady Finger, are over a

hundred years old. In any new variety the really crucial test comes only when it is in the hands of the general public. The real sorting of varieties can come only then. The general public will determine which names are to stand and which will be relegated to obscurity or extinction.

Collaborators

The persons who have collaborated in this work have contributed not only time, land and labor but also have furthered the work materially by expert advice on the whole problem of potato production. Their names are appended.

All of the increase stock for 1946 was in the hands of these men. Many of them deal almost exclusively in carlot orders and do not like to bother with small lots. All of them, however, have been willing to fill orders for experimental purposes and to sell to other seed growers. Some offers to buy the entire surplus in one transaction have been rejected. Each individual has the privilege of setting any price he chooses on his stock. The 1946 selling price actually has been only a little higher than was charged for tuber-unit, foundation stock. In the autumn of 1947 these persons will still have most of the surplus but many other seed growers will have small quantities available: Fred Ashworth, Heuvelton, New York; Kennard Carpenter, R. D. 1, Dryden; H. J. Evans, Georgetown; Wm. Hodnett, Fillmore; Edw. L. Kent, Andover; George Mehlenbacher, Wayland; A. J. Pratt, Agri. College, Ithaca; Favor Smith (Lake Placid Club Farms), Lake Placid; J. A. O. von Sopp, Skaneateles; Wm. Stark, Chestnut Ridge Road, Glens Falls; George Webster, Chestnut Ridge Road, Glens Falls.

PERMANENCE OF GREENING OF POTATO TUBERS

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Greening of potato tubers by light causes losses during the preparation of the tubers for cooking or dehydrating. It may affect color descriptions of new varieties and of surface and cortical diseases. It is claimed to be correlated with a development of solanin, a poisonous alkaloid. Greening may occur in the field, in storage, and in the market. It is of interest to know whether any greening fades out under any conditions. This question is mentioned only rarely in the literature. In Montana, "the color will usually disappear from green potatoes after they are stored in darkness for several weeks, unless the greening is very pronounced" (3, p. 40).

[1]Head of Department of Plant Pathology.

Chippewa, Katahdin, and Green Mountain tubers from a Maine field were used for a greening and fading experiment in the fall and winter of 1946-1947. The tubers were washed, numbered with an indelible pencil, and grouped by threes in each variety. Each group was exposed to light for a given period and then kept in the dark for a while, except that some were peeled and sliced up at the end of the greening period, and a few had become partly green in the field and were not greened further. The dorsal surface[2] of each tuber was the one exposed to light each day, and was used for judging color. Color was judged under "Daylight" fluorescent lamps according to Ridgway (4) and Maerz and Paul (2). A few tubers were exposed to light from fluorescent lamps similarly in cool and warm rooms and showed that under the same lighting conditions greening occurred more slowly at 40° F. than at 70° F. Otherwise the tubers were greened in a rather cool greenhouse room by natural light only in the period from the 16th of October to the 15th of November. The three varieties greened at approximately the same rate.

Results of the test are given in tables 1 and 2 with respect to observations of the greened surface. The longer in the light, the more pronounced became the green. Storage in the dark was generally characterized by the development of more red, showing as pink or brown shades. In spite of this, which might mask slight changes in the green, there was evident some fading of the green in 31 days after the 2- or 4-day greening. This fading occurred faster in the warm storage.

Sprouts were inhibited in the warm storage after the 31-day examination by coating the tubers with a dust containing the methyl ester of alpha-naphthalene-acetic acid. This dust had no effect upon the work otherwise, judging from uncoated control tubers, being washed off for each examination for color. After another month in the dark there was no appreciable change in the green from the color at the end of the first month, and there was still generally more red than at the beginning of storage in the dark. After a further storage of three months in the dark, there was little change at approximately 35° F., but at 75° F. the color had become darker brown.

Subepidermal greening was noted upon sectioning the cortex at the end of the greening period and after a week, a month, and 5 months in the dark. After 2 days' greening there was very shallow cortical greening, which became lighter in warm storage than in cool in 31 days

[2]The surface that is more convex and contains more eyes, and that usually is uppermost in the soil (1, p. 6).

TABLE 1.—*External color of tubers of three varieties after exposure to late autumn light in a greenhouse.*

Days in Light	Color Developed					
	According to Ridgway			According to Maerz and Paul		
	Chippewa	Katahdin	Green Mountain	Chippewa	Katahdin	Green Mountain
0	XVI. Cream	XXX. Cream buff	XXIX. Cinnamon buff	9-E-2	11-E-3	11-F-5
2	XVI. Naples yellow XXX. Colonial buff	XXX. Colonial buff; deep colonial buff	XXX. Deep colonial buff	11-G-2	11-H-3	11-H-3
4	XVI. Naples yellow; olive lake. XXX. Deep colonial buff	XXX. Olive ocher	XXX. Olive ocher	11-H-3	12-G-3	12-F-3; 12-H-4
7	XVI. Olive lake	XVI. Olive lake; dull citrine	XVI. Olive lake; yellowish citrine.	12-K-2	12-I-2; 13-J-2; 13-J-3	12-I-3; 12-J-2; 12-K-1
14	XXX. Ecru olive; light yellowish olive	XXX. Buffy olive	XXX. Ecru olive XXX. Olive yellow; light yellowish olive	13-H-4; 13-J-2; 13-J-3	14-I-1; 14-J-3; 14-K-3	12-L-1
31	XXX. Yellowish olive. XXXI. Kronberg's green	XXXI. Kronberg's green; jade green	XXXI. Rainette green	22-I-1; 22-I-3	22-H-1; 22-H-4; 22-I-1	21-K-3; 21-K-4

TABLE 2.—*Color changes in surface of greened tubers in dark.*

Days in Light	Changes in Dark[1]							
	In 7 Days		In 31 Days		In 2 Months[6]		In 5 Months[7]	
	Cool[2]	Warm[3]	Cool	Warm	Cool	Warm	Cool	Warm
2	More red except in Kat.	More red except in Kat.	Less green; more red	Less green[4]; more red	More red	More red	More red in Chip. and G. M.	Darker brown in Chip. and Kat.
4	More red	More red, except more green in Kat.	Less green in Chip.; more red	Less green in Chip.[5]; more red	Slightly more red	More red	Lighter in G. M.	Darker brown
7	G. M. more red; others greener	Some more red	More red in Chip.	More red in Chip.	Somewhat more red	More red	No change	Darker brown
14	Slightly lighter gr. in Kat.	Slightly lighter gr. in Kat.	More Red in Chip.; G. M. darker	G. M. darker	More red in G. M.	More red in Chip. and G. M.	No change	Darker brown
31	——[8]	——[9]	More red; Kat. darker	——[9]	——[8]	——[9]	No change	——[9]

[1]From colors given in Table 1. Three sets of samples.
[2]At about 35° F.
[3]At about 75° F.
[4]More loss of green below skin than in cool storage.
[5]More loss of green below skin than in cool storage, in all varieties.
[6]Green same in 2 months as in 31 days.
[7]In comparison with color after 2 months in dark. Same tubers.
[8]No examination at this time.
[9]No samples.

and which in 5 months disappeared in warm storage in all varieties and in cool storage in Chippewas.

After 4 days' greening there was very shallow cortical greening which was more pronounced in Katahdins than in the other varieties, which faded more in warm than in cool storage in 31 days, and which disappeared in warm storage in Chippewas and Green Mountains in 5 months.

After 7 days' greening the cortical greening reached a depth of about 1/16 inch in Katahdins but was very shallow in the other two varieties. Here temperature in the dark had no effect in 31 days but in 5 months the cortical greening was still distinct in cool storage. After 5 months in warm storage, the cortical greening was absent in Chippewas, faint in Green Mountains, and a shade less pronounced in Katahdins than in cool storage.

After 14 days' greening and a week in the dark, cortical greening was more pronounced in Katahdins than in the other two varieties. Then after 31 days in the dark, temperature had had no effect, but after 5 months in the dark, there was slightly less greening in the warm storage than in the cool.

After 31 days' greening or after field greening, 5 months of cool storage left the cortical green still very marked.

Conclusions

Potato tubers greened faster at ordinary room temperature than in a cool place. Greening, as seen through the skin, faded faster in the dark at 75° F. than at 35° F., faded somewhat in a month of dark storage after 2 to 4 days' exposure to light, faded in 5 months only in the warm storage after 7 to 31 days' exposure to light, and was obscured or replaced by red or brown when fading in dark storage. Cortical greening developed faster and faded less in Katahdins than in Chippewas and Green Mountains, faded faster in warm than in cool storage, and faded less after longer exposure to light. Culinary tubers if exposed to light for 2 days may require over a month in warm dark storage for fading of the green, and if exposed to light for longer periods may require several months of warm dark storage for fading of the green.

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VIRUS X IN THE NEWER POTATO VARIETIES AND THE TRANSMISSION OF THIS VIRUS BY THE CUTTING KNIFE[1]

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INTRODUCTION

In New York State, mosaic potato plants have appeared recently in fields of the relatively new potato varieties, Katahdin, Sebago, and Chippewa. These varieties are known to show either field resistance to the viruses causing mosaic in the older American varieties or to react with symptoms differing markedly from those observed in these fields. As these three varieties constitute a large percentage of the potatoes grown in this state and in some other potato-growing regions of the United States, it was thought worthwhile to identify and to study the virus or viruses responsible for this mosaic disease and to examine the possible means of transmission in commercial stocks.

Mosaic symptoms are known to be caused by any one of several distinct viruses or a combination of two or more. In the older American varieties the mosaic diseases most frequently encountered are mild mosaic and rugose mosaic. The former disease is caused by potato virus A[3] and is characterized by mottled areas of variable size and shape located over the surfaces of the leaves without regard to the veins. However, since these older varieties of potatoes are 100 per cent infected with virus X[4] it is impossible to determine the exact symptoms attributable to virus A infection alone. Sebago, Katahdin, and Chippewa have been shown to be highly resistant, if not immune, to virus A under field conditions (Stevenson and Clark, 1938, and Clark *et al*, 1933).

The principal causal agent of rugose mosaic, which affects both the old and newer varieties of potatoes, is the veinbanding strain of potato virus Y.[5] Here, too, the presence of virus X in all the older American varieties of potatoes makes it impossible to determine whether the symptoms of these varieties result from virus Y alone or from virus X and virus Y together. The newer varieties and unnamed seedlings are also susceptible to virus Y and may cause symptoms varying from a very mild

1. An abstract of the thesis, from which this material was taken, was pubished *In* Cornell University Abstracts of Theses, pp. 168-170. Cornell University Press, Ithaca, New York, 1946.

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The author is indebted to Professor F. M. Blodgett for advice and encouragement throughout these studies.

3. Solanum virus 3 Smith, *Marmor solani Holmes.*
4. Solanum virus 1 Smith, *Marmor dubium Holmes.*
5. Solanum virus 2 Smith, *Marmor cucumeris* var. *Upsilon,* Holmes.

mottle to severe veinal necrosis and leaf drop even in the absence of virus X. Mosaic symptoms caused by virus X alone have been reported or Chippewa (Larson, 1943). Jones, Vincent, and Burk (1940) reported that when Katahdin was inoculated with virus X from older varieties of potatoes, no symptoms resulted, but when infected with a virus of the X type from a seedling potato plant, a definite mottling of the foliage occurred.

At the present time there is much controversy as to whether potato virus B is a strain of virus X or a separate virus. Virus B has not been shown to cause symptoms in either the older or newer American varieties of potatoes when the plants are grown from infected tubers. It has been shown, however, to be present in the older American varieties of potatoes as evidenced by top necrosis resulting when these varieties are grafted to certain European varieties (Murphy and McKay, 1932, and Dykstra, 1935).

Determination of the Virus Present

The first problem was to determine the identity of the virus causing the mosaic symptoms in the varieties Katahdin, Sebago, and Chippewa. A number of differential hosts or indicator plants was used as an aid in this identification. Virus X causes distinctive symptoms in related species, including *Datura Stramonium* L., *Lycopersicum esculentum* Mill., *Capsicum annum* L., and *Nicotiana tabacum* L. (Johnson 1925). Numerous workers have substantiated these results and also have shown that different strains or types of virus X give different symptoms on these indicator plants. However, only on pepper are symptoms produced by all known strains.

Potato seedling 41956[6] does not contract virus X but readily contracts virus A (Schultz *et al,* 1934) and virus Y (Stevenson *et al,* 1939) and under suitable conditions these viruses produce characteristic symptoms. Virus B causes top necrosis whereas Virus X causes a mottle or no symptoms in the variety Arran Victory (Murphy and McKay, 1932).

Procedure:

Fifty-five mosaic plants of the variety Katahdin, five of the variety Sebago, and 18 of the variety Chippewa were grown in the greenhouse from tubers of mosaic plants collected from fields throughout the state. Symptoms occurring on these plants were noted at all growth stages.

Preliminary inoculations to pepper plants indicated that virus X was present in all of the mosaic plants. In order to substantiate these results and to gain an approximation of the type of virus present, me-

6. U. S. D. A. seedling.

chanical inoculations were made from each of these plants to duplicate sets of three young and vigorous plants of Datura, tobacco, tomato, pepper, and the potato variety Katahdin. The tubers produced by the Katahdin plants were replanted.

The method of making mechanical inoculations was briefly as follows: the leaves to be inoculated were dusted with #400 carborundum and then rubbed gently with sterile cheesecloth pads dipped into juice obtained by triturating leaves of the source plant with a sterile mortar and pestle. In making routine inoculations from potato plants to indicator plants for the purpose of determining the presence or absence of virus X a more rapid method was used. In this method a potato leaf was plucked from the plant and folded into a tight ball by means of a large pair of forceps. The folded leaf was triturated against the rough side of a pot label and then rubbed on the leaves of the plant to be inoculated.

Grafts of the cleft type were made using scions from the 78 mosaic plants and plants of the seedling 41956 as stocks. Each graft was successfully completed two or more times. The grafted plants were observed for eight weeks.

Cleft grafts were also made to plants of the potato variety Arran Victory to test for the presence of virus B. Since Arran Victory may carry a mild strain of virus X with no symptoms (Salaman 1938), the plants to be used as stocks were tested for virus X by inoculations to pepper plants. This procedure was followed in assuring X-free potato plants for all experiments.

Results:

The symptoms on all of the indicator plants showed that virus X was causing the mosaic symptoms in all of the Katahdins, Sebagoes, and Chippewas. This evidence was substantiated by the results of serological tests.[7] Juice of Datura plants infected with the virus obtained from one of the potato plants showing a brilliant mottle as well as that from plants infected with one of the mild types gave positive precipitin reactions with an antiserum prepared with Johnson's ringspot strain of virus X.[8]

The fact that no symptoms appeared in the plants of potato seedling 41956 indicated that neither virus A nor virus Y was involved. The absence of top necrosis on any of the grafted Arran Victory plants revealed that virus B was not present in any of the mosaic plants. There was no evidence of the presence of a new virus on any of the inoculated or grafted plants.

7. Performed by Professor A. F. Ross of the Department of Plant Pathology, Cornell University, Ithaca, N. Y.

8. This ringspot strain was supplied by Dr. L. O. Kunkel, Rockefeller Institute for Medical Research, Princeton, N. J.

TABLE 1.—*Reaction of potato and indicator plants to infection with the X virus.*

	Katahdin from Diseased Tuber	Pepper (Mechanical Inoculation	Tobacco (Mechanical Inoculation)	Datura (Mechanical Inoculation)	Tomato (Mechanical Inoculation)	Arran Victory (Graft)	41956 (Graft)
Mild X	Latent or very faint mottle	Systemic necrosis; leaf fall	No symptoms or a very few yellow flecks and a faint mottle	No symptoms or a very faint mottle; sl. V.C.,* sl. V.B.,** very few superficial necrotic spots	No evident symptoms	No symptoms or a very faint mottle. No top necrosis	No symptoms
Medium X	Medium mottle; occasionally scattered necrotic spots	Systemic necrosis; leaf fall; necrosis of stem	Medium mottle; med. V.B.; few necrotic ring spots; many necrotic lines and flecks	Medium mottle; med. V. B., med. V.C.; few superficial necrotic spots	No evident symptoms	Medium mottle; very few necrotic spots; leaves slightly rugose; no top necrosis	No symptoms
Severe X	Brilliant mottle; distorted leaves; pronounced V. B.; scattered necrotic spots; plants stunted	Systemic necrosis; leaf fall; pronounced stem necrosis	Brilliant mottle; many necrotic rings and many necrotic flecks; intense V. B.; plants greatly stunted	Numerous necrotic spots and necrotic areas; brilliant mottle; highly rugose; intense V.C.; plant greatly stunted	Few necrotic spots on inoculated leaves; brilliant systemic mottle	Brilliant mottle; scattered necrotic spots; leaves distorted; plant stunted; no top necrosis	No symptoms
Necrotic X	Brilliant mottle; distorted leaves; innumerable necrotic spots; plant stunted	Entire plant dead	Many necrotic rings on all leaves; some leaves dead; plant greatly stunted	Necrotic spots and areas on all leaves; some leaves dead; highly distorted leaves; plant greatly stunted; entire plant may be killed	Very numerous black, necrotic spots on leaves; some leaves killed; entire plant may be killed	Very numerous pinpoint black necrotic spots on leaves; mottle; leaves distorted; plant stunted; no top necrosis	No symptoms

*Veinclearing. **Veinbanding.

The original 78 mosaic plants were divided into four groups on the basis of symptoms as follows:

	Symptoms	Name Assigned to Causal Agent
Group 1	Very faint mottle	Mild X
Group 2	Medium mottle	Medium X
Group 3	Brilliant mottle	Severe X
Group 4	Brilliant mottle with many pin-point necrotic spots in light colored areas	Necrotic X

The border lines between these types are not sharp: the division is made in this manner only for convenience in presenting the material (table 1). There was no evidence to indicate that all plants in a given group were infected with a single strain of virus X. It is more probable that several strains were involved, possibly in the same plant.

When inoculations were made from these 78 plants to Datura, the Datura plants showed a range of symptoms typical of virus X infection and closely paralleling in severity those on the potato from which they were inoculated. Symptoms of varying degrees of severity were also noted on the tobacco, tomato, and pepper plants. These symptoms likewise paralleled in severity the symptoms on the potato plants from which the inoculum was obtained.

The majority of the diseased plants found in the field were infected with the medium type of virus X (table 2). Since only those plants

TABLE 2.—*Number of plants found in the field infected with the several types of virus X.*

Variety	Mild X	Medium X	Severe X	Necrotic X
Katahdin	15	36	3	1
Sebago	1	3	1	0
Chippewa	4	10	1	3
Total	20	49	5	4

showing a mottle in the field are represented this cannot be taken as an accurate picture of the types of virus X infecting these varieties. In other experiments involving inoculations to indicator plants, it was found that many symptomless plants of these three varieties were infected with a mild type of virus X.

MECHANICAL AND GRAFT INOCULATION TO HEALTHY POTATO PLANTS

Since the symptoms resulting from the inoculations from virus diseased potato plants to healthy plants often aid in diagnosing the

disease, it was thought worth while to study the reactions of healthy potato plants to mechanical and graft inoculation with virus X as found in the mosaic plants of Chippewa, Sebago, and Katahdin. Green Mountain plants which are infected with both virus X and virus B were also used as inoculum to give a comparison of symptoms attributable to viruses X and B in combination as well as to virus X alone.

Smith (1933) reported healthy Katahdin potato plants infected with virus X by mechanical inoculation first showed circular necrotic lesions on the inoculated leaves followed by a mild mottling of the top leaves, the remaining leaves developing a network of necrotic lines more pronounced on the lower surfaces of the leaves than on the upper. Schultz *et al* (1934) reported that with tuber graft inoculations from Green Mountain to healthy Katahdin tubers, top necrosis of the Katahdin plants resulted. Identical results were obtained when shoot graft inoculations were made (Schultz and Raleigh, 1936). Evidence has been presented that Katahdin shows no necrosis when graft-infected with virus X, but reacts necrotically to graft infection with virus B (Cockerham, 1943).

Procedure:

Mechanical inoculations were made from each of the 78 mosaic plants collected in the field to two actively-growing X-free plants of each of the varieties Katahdin, Sebago, and Chippewa. In addition, mechanical inoculations were made from two Green Mountain plants to five healthy plants of the varieties Katahdin, Sebago, and Chippewa.

Successful grafts were made from each of the 78 mosaic plants collected in the field to at least two healthy X-free plants of the varieties Katahdin, Sebago, and Chippewa. Grafts were also made from Katahdin plants infected with mild X, medium X, and severe X and from Green Mountain plants to X-free plants of 9 other varieties (table 3). The Green Mountain scions, infected with a mild type of virus X in addition to virus B, and the Katahdin scions, infected with the different types of virus X each came from plants which were progeny of single hills.

Symptoms on all inoculated plants were observed and recorded during an eight-week period. To test for the successful transmission of mild virus X, reinoculations were made to Datura and pepper plants.

Results:

Virus X was transmitted to approximately 95 per cent of the mechanically inoculated plants and to all of the plants on which successful grafts were made.

On approximately 40 per cent of the plants mechanically inoculated from mosaic Katahdin, Sebago, and Chippewa plants the first symptoms

TABLE 3.—*Results of grafting to X-free varieties of potatoes.*

Variety Used As Stock	Green Mountain* X-and B-infected	Katahdin Mild-X-infected	Katahdin Med. X-infected	Katahdin Severe X-infected
Katahdin	Slow developing top necrosis	Mild mottle or no symptoms	Medium mottle	Brilliant mottle
Sebago	Severe top necrosis	"	"	"
Chippewa	Some necrotic spots on terminal leaves. Only a very few leaves of terminals died.	"	Medium mottle Leaves ruffled	Brilliant mottle Leaves ruffled
Sequoia	Severe top necrosis	Mild to medium mottle	Brilliant mottle	Very brilliant mottle
Pontiac	"	No symptoms	Medium mottle	Brilliant mottle
Ontario	No symptoms	No symptoms or a faint mottle	"	Brilliant mottle Leaves ruffled
Seneca	Severe top necrosis	Mild mottle or no symptoms	"	Brilliant mottle
Cayuga	No symptoms	No symptoms or a slight mottle	Faint to medium mottle	"
Empire	No symptoms	No symptoms	Medium mottle	Brilliant mottle
Menominee	Severe top necrosis	"	"	"
Norkota	Severe top necrosis	Faint mottle or no symptoms	Faint - medium mottle	Very brilliant mottle
Erie	Severe top necrosis	No symptoms	Medium mottle	Brilliant yellow mottle

*All Green Mountain scions used came from plants shown to be infected with virus B by grafting to Arran Victory.

were black necrotic spots (1-4 mm. in diameter) appearing on the inoculated leaves. These spots were more frequent when the severe and necrotic types of the virus were used (50 per cent) than when the mild type was present (20 per cent). No correlation was evident between the presence of these spots and the successful systematic transmission of the virus.

Systemic symptoms occurred first on young leaves and then spread to other leaves of the plants. In all cases the mottling that appeared on the new growth of any particular plant was very similar to that appearing on the plant from which the inoculum came. With approximately 60 per cent of the inoculated plants a mottle was the only symptom.

When mechanical inoculations were made from Green Mountain plants a faint mottle, typical of a mild type of virus X, appeared on the inoculated plants. The presence of virus B in the Green Mountain plants did not appear to alter the symptoms.

When diseased Katahdin, Sebago and Chippewa scions were grafted to healthy X-free Katahdin, Sebago, and Chippewa plants symptoms

developed similar to those in plants from which the scions were taken. No top necrosis occurred, thus providing additional evidence of the absence of virus B in the original mosaic plants.

From table 3 it can be seen that the chief differences in the reactions of the different varieties to the scions used were in those cases where Green Mountain scions containing the viruses X and B were used. Seven of the varieties tested developed top necrosis. The development of top necrosis on the Katahdin variety was slow. The reaction in the Chippewa variety consisted of the appearance in the apical leaves of numerous necrotic spots, which occasionally coalesced and caused death of the apical portion. When this occurred the necrosis extended only a short distance down the stem. On the other hand no symptoms were obtained on the varieties Ontario, Cayuga, and Empire, although mechanical inoculations to pepper and grafts to Arran Victory showed the presence of both viruses X and B.

In the grafts from the X-infected Katahdin plants, all of the varities reacted in essentially the same manner: that is, with mottle symptoms in the case of the severe and medium types of virus X, and no symptoms or a very faint mottle as a result of infection with mild virus X. The mottles caused by both types of the virus X were more brilliant on Sequoia than any other variety. In all varieties, the severe virus X caused the most intense symptoms, medium virus X intermediate, and mild virus X the least intense.

Transmission of Virus X by Means of the Cutting Knife

Since virus diseases are not commonly transmitted through the true seed, potato plants may be considered to be free of virus X when grown from seed.

No insect vector has been established for virus X. Dykstra (1933) and Dykstra and Whitaker (1938) have carried out the most extensive experiments in the search for an insect capable of transmitting this virus.

It is generally considered that seedlings become infected by means of foliage contact with X-infected plants. Schultz *et al* (1937) and Loughnane and Murphy (1938a) have shown by controlled field and greenhouse experiments that virus X can be transmitted to adjacent healthy plants in this manner. Numerous virus workers, including Bawden (1942), have expressed the belief that foliage contact will not account for all infections in the field.

Loughnane and Murphy (1938b) did not obtain transmission of virus X by root contact. Roberts (1946) obtained some evidence of transmission in this manner. However, he obtained only one successful transmission.

Consequently, it appeared desirable to find out if virus X could be transmitted from tuber to tuber by means of a cutting knife. Valleau and Johnson (1930) in a discussion of the means of which virus X is transmitted, state that transmission by this means had not been accomplished. Apparently no recent work on this subject has been reported in the literature.

Procedure:

For the inoculum two sets of tubers, each originating from one hill in the field, were selected. One set was shown to be infected with a mild type of virus X and the other with a severe type of virus X. Sprouted X-free tubers of the varieties Katahdin, Sebago, and Chippewa were cut into four seed pieces with a sterile knife. Three of these seed pieces were inoculated by one of two methods. In method A, a sprout (⅛-¼ inch long was injured with a knife contaminated by cutting through a virus-infected tuber. In the case of method B, a knife contaminated in the manner described above was used for cutting a ¼ inch slice from the healthy seed piece. Great care was taken to avoid cutting through a sprout. An uninoculated seed piece was planted from each tuber. Inoculations were made to pepper plants from plants arising from these uninoculated seed pieces as additional evidence that only X-free tubers were used. All plants from an infected tuber were discarded. Seed pieces were planted immediately in separate pots spaced so as to prevent contact of the leaves of adjacent plants as the plants grew.

Since the severe virus X used causes a brilliant mottle on all the varieties of potatoes used in this experiment, the plants from seed pieces inoculated with this type of virus X were examined daily for symptoms. In order to make certain that a mild type of the virus had not protected some of the plants against infection with the severe type, all plants remaining symptomless for 30 days after inoculation were tested for the presence of such a mild strain by inoculation to pepper plants.

Since mild virus X is carried without symptoms or causes only a faint mottle in Katahdin, Sebago, and Chippewa varieties, it was not always possible to detect infected plants by inspection. Therefore, after a period of ten weeks from the date of inoculation, leaves from each haulm of each plant were inoculated to two Datura plants.

Results:

From table 4 it is evident that under the conditions of this experiment transmission by cutting knife did occur. When all varieties, with both methods of inoculation and both types of virus X are averaged together, 9.3 per cent transmission took place. When only inoculation with the severe type of virus is considered, 17.5 per cent transmission occur-

red, whereas mild type was transmitted in 1.1 per cent of the attempts. An extremely high percentage of transmission (50 per cent) was obtained when Sebago seed pieces were cut with a knife contaminated with the severe virus X. These results may indicate high susceptibility of Sebago to this type of inoculation, but confirmation is needed before any definite conclusions can be drawn.

TABLE 4.—*Cutting knife transmission of mild and severe types of virus X*

	Severe X				Mild X			
	Inoculation Method A*		Inoculation Method B**		Inoculation Method A		Inoculation Method B	
	Trans. / Inoc.	Trans.	Trans. / Inoc.	Trans.	Trans. / Inoc.	Trans.	Trans. / Inoc.	Trans.
		Per cent		Per cent		Per cent		Per cent
Katahdin	3/59	5.1	9/58	15.5	0/63	0.0	0/59	0.0
Sebago	2/50	4.0	28/56	50.0	2/51	3.9	0/63	0.0
Chippewa	5/37	13.5	3/26	11.5	1/29	3.4	0/18	0.0
Totals	10/146	6.9	40/140	28.6	3/143	2.1	0/140	0.0

*Sprouts were injured with an X-contaminated cutting knife.
**Healthy seed pieces were cut with an X-contaminated cutting knife.

SUMMARY

Potato virus X was found causing mosaic symptoms in potato plants of the varieties Katahdin, Sebago, and Chippewa collected from New York State potato fields.

The mosaic symptoms found on the different diseased plants varied in severity from a very mild mottle to a brilliant mottle with numerous small necrotic spots in the light-colored areas. When inoculations were made to Datura, tomato, pepper, and tobacco plants variable symptoms resulted, paralleling in severity the symptoms on the original potato plants.

Top necrosis did not appear on grafting to Arran Victory from each of the 78 mosaic plants found in the field; thus demonstrating the absence of virus B. The reactions are given of twelve X-free American varieties to graft infection with virus X and virus B from Green Mountain scions and from Katahdin scions infected with mild, medium or severe types of virus X.

Approximately ten per cent of the healthy seed pieces cut with a virus X-infected knife became infected with virus X. A considerably higher percentage of transmission was obtained with the severe type of virus X than with the mild type.

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SECTIONAL NOTES

COLORADO

In general the Colorado crop is good. Observations and grower reports point toward good quality of both Bliss Triumph and Red McClures. The Irish Cobblers seem to be of poorer type and quality than usual. In Northern Colorado the yields are average, whereas in the San Luis Valley they are apparently better than average especially for that district. It is not unusual in the Valley to find yields of more than 300 sacks per acre. The labor shortage is still acute, being worse in some areas than it was last year. However, labor for the potato harvest is reported to be more favorable than for some of the other crops. Digging is well under way and the bulk of the crop will be harvested by the 15th of October. The quality is better than last year with all indications pointing to the fact that a higher percentage of the crop will be shipped as No. 1 grade. Unless something unforeseen develops, there will not be a great deal of trouble from rots in storage and in shipment. The car situation is tight, it is predicted that it will remain so throughout most of the shipping season.

The potato Certification Service, Colorado A & M College at Fort Collins will have for distribution some of the new scab-resistant seedling No. 6317. There will probably be more demand for this potato than the supply available. In order to make more seed available for next year, the requests from the certified seed growers will be taken care of first. This potato is a Katahdin-type round white and usually produces a good yield of high quality potatoes. Its eating quality is also reported to be good. It is intermediate in maturity. In addition to carrying scab resistance the tests in Colorado indicate that it also carries a high degree of resistance to leafroll and mild mosaic. It may carry some late blight resistance, but the Colorado tests have not been conducted under conditions favorable for severe late blight. This seedling is now being described and will be named this fall or during the coming winter. (Oct. 8)—Cecil W. Frutchey.

INDIANA

We have had ideal fall weather for harvesting the late and main crop potatoes, the quality of which is very good and the yields average or above. The continued hot and dry weather during the month of August checked vine growth and, followed by the rains in early September, caused some second growth on Sequoias and Katahdins. Our final records will not be available until the first part of December. (Oct. 6).—W. B. Ward.

NEBRASKA

Potato harvesting in Nebraska began somewhat earlier than usual, because of a frost which killed the vines in many fields. Its general effect, however, was spotted, since some fields are still growing vigorously at this writing.

Nebraska growers are quite disappointed, as a whole, with their crop of potatoes. The season began adversely, June having more rainfall than any month according to the Nebraska weather record. Following this, planting conditions were very poor, as many potatoes were planted in the mud. In July the temperature became very high, and throughout August and during the first part of September, no moisture was received in most of the late potato area. The month of August was the second hottest and second driest ever recorded in the Nebraska weather bureau.

As a result of these extreme conditions, yields have been materially reduced on the dry land. The quality is also going to be reduced, because the ground was packed by the drought so that tubers simply could not grow properly. Even the growers using irrigation suffered, because the heat was so intense they could not put on the water fast enough to maintain continued growth.

The yields under the dry land conditions vary from 40 to 75 bushels per acre whereas 110 to 125 bushels are considered average. The growers using irrigation probably will have 100 bushels less than usual, and instead of many fields yielding from 350 to 400, it will probably be 250 to 300.

Our harvesting operations are now well under way, with probably one-third to one-half completed at this time. It will probably take another ten days to complete the job, providing the excellent weather conditions continue. Table stock is being sold at approximately $2.30 per cwt. f.o.b. cars for U. S. 1 grade. This is slightly above the support price at the present time. Not too many sales are being made, as most of the crop is going into storage. Seed sales have been very spotted to date, and no market is established. (Oct. 10). —MARX KOEHNKE.

NEW JERSEY

New Jersey potato growers have finished harvesting the largest yield of potatoes ever produced in the state. The average yield of the commercial acreage is estimated at 230 bushels. Several growers have reported yields above 600 bushels per acre, with four varieties producing yields of more than 700 bushels to the acre. These yields were officially measured by the Monmouth County Agricultural Agent in a variety test conducted cooperatively by the Extension Service and the

Experiment Station. Excellent quality has been produced on most of the acreages and a very high percentage of U. S. 1's has been shipped. Favorable growing conditions coupled with the use of DDT, were contributing factors in these outstanding yields.

With average yields increasing throughout the country at a rate considerably above the increases in consumption, the potato industry must either reduce the total acreage still further or seek much greater markets for the crop in manufactured by-products such as alcohol, starch, flour, animal feed, glucose or as processed foods. These outlets will take time to develop and the logical immediate remedy for overproduction is to reduce acreage.

At a recent meeting, the trustees of the New Jersey State Potato Association went on record as favoring controlled acreage with price support at a rate that would guarantee the cost of production as a long time policy for the potato industry. Their spokesman, William Duryee, was authorized to report this action at the recent congressional hearing in Lancaster, Pennsylvania. (Oct. 17).—J. C. CAMPBELL.

NEW YORK

During the week of the 22nd of September, some up-state sections had three severe frosts with a temperature of 20 degrees on the 26th. Because of late planting and a dry August, the potatoes vary from small to medium, but the quality is good. Although we had a general blight infection throughout the state, our growers were on the job with sprayers and dusters and kept it well under control. All growers are so busy harvesting that very few potatoes are going to market. The local demand is good. Probably 70 per cent of our up-state growers are under support, and will store nearly all their potatoes, and take advantage of the winter prices. Perhaps the tax situation figures into this to a certain extent. In any event with the light yield and a good demand there promises to be a ready movement of all available table stock. Our final inspection of certified acreage is being made primarily to detect infections that show on tubers. Although no complete figures are available indications are that we will have a higher percentage of seed passing certification this year than during the season of 1946. (Sept. 29). —H. J. EVANS.

OHIO

Our potato crop is late due to delayed planting caused by the exceptionally wet spring. The early crop was about 75 per cent of 1946. Harvesting is practically completed with 90 per cent of the crop marketed.

Most of the late crop was frosted last week and harvesting is now

under way. Our yields are generally poor because of the short growing season and poor stands. The total yields of both the early and late crops are expected to be 2 to 2½ million bushel below that of 1946.

Our prices have remained steady with pecks selling at 50 cents and 50 pound paper at $1.50 delivered.

Weed growth in the early crop was exceptionally heavy, making it necessary to use several flame burners. Growers used the flame burners about six days before and again just previous to harvesting. This method cleared the fields of weeds and facilitated harvesting. (Oct. 7).—Earl B. Tussing.

PENNSYLVANIA

Heavy frosts have killed the potato vines throughout the state and harvesting is in progress. Many of the crops are large, and most growers have yields varying between 400 and 500 bushels to the acre. Late blight has been a serious problem and some rot is present, but the losses are not serious since most growers did an excellent job of spraying. The yields have not varied much in the different plots where the potatoes have been sprayed with bordeaux, the carbamates, or the fixed coppers. Blight control however, seems slightly better where bordeaux was used. (Oct. 1)—O. D. Burke.

SOUTH DAKOTA

Potato harvesting is still in full swing. Ten more days of good weather will find the crop under cover. Five washers are operating in the potato area and two to nine cars a day are being shipped. Most of our certified stock is going into storage. The final field inspection report shows that 5691 acres have passed certification. This consists of Bliss Triumphs, 3546; Cobblers, 1325; Red Warba, 262; Pontiacs, 249; and 309 acres of other varieties. These are located in Clark County with 3798 acres; Codington, 1282; Hamlin, 248; Kingsbury, 114; Day, 110, and other counties 139 acres. The yields are better than expected with many fields producing more than 175 bushels per acre. A referendum on a proposed marketing agreement for South Dakota will be conducted in October. This area will include only these counties in the Northeastern part of the state. (Oct. 8)—John Noonan.

WASHINGTON

Late Blight of potatoes has appeared in South Central Washington, where it is doing considerable damage to the vines of the late potato crop.

Inasmuch as growers in this area ordinarily do not spray for the late blight, they are not prepared to combat the disease on the vines.

Since the growing season is nearly over, they are interested in digging the tubers, without infecting them, and thus prevent carrying the disease to the storage bins. They have been advised regarding the best methods of avoiding tuber contamination.

It has been interesting to note that over-head irrigation has been responsible for an extensive spread of late blight where this form of applying water has been used. (Oct. 6).—M. R. HARRIS.

WYOMING

Harvesting of potatoes in Wyoming is well under way. The yield of the dry land grown potatoes is about 25 per cent less than a year ago and the yield of irrigated potatoes will also be somewhat less than that of last season. This reduction in yield is due to a less favorable growing season. We had very unfavorable weather at planting time which delayed planting and a frost on the 14th of September, killed, or nearly killed, the vines in most of the fields. It is a little too early to predict the quality of our crops. The size of the tubers will be smaller this year, but the quality in general should be quite good. (Oct. 13).—WM. A. RIEDL.

CANADA

Preliminary returns from the various provinces with regard to the seed potato acreages passing inspection in 1947 are only now being received. In Prince Edward Island, reports show that 11,900 acres of Irish Cobbler; 9,195 of Green Mountain; 5,315, Sebago; 2,617, Katahdin; and 132 acres of Sequoia passed field inspections. These figures are somewhat lower, on the whole, than those of 1946.

In the Province of Quebec, 1,593 acres of Green Mountain and 67 of Irish Cobbler passed inspection. The acreage that passed inspection in this Province is slightly higher than in 1946.

Reports from the Prairie Provinces indicate that in Manitoba the principal varieties will be: Irish Cobbler, 282 acres; Bliss Triumph, 63; Katahdin, 56; Columbia Russet, 41; Warba, 30; Early Ohio, 28; Green Mountain, 25; and Netted Gem, 24 acres. In Saskatchewan, returns so far show: Netted Gem, 43 acres; Early Ohio, 29; and Irish Cobbler, 11 acres. In Alberta, acreages passing inspection are: Netted Gem, 491; Carter's Early Favorite, 10; Warba, 9; and Canus, 6. (Oct. 8).—W. A. FOWLER.

PROVINCE OF ONTARIO

The first killing frost of the season occurred on the 23rd of September. Since all tops were destroyed in practically all the potato

growing sections, digging is now progressing favorably and will probably be general about the 10th of October. Skins are firming well and conditions are ideal for harvesting. The quality of Ontario potatoes is considerably above average, although the total output will be below that of last year. Tubers from most fields are in good condition for storage, with slight damage from blight appearing only in a very occasional crop. A large percentge will grade as Canada No. 1 with some total yields averaging more than 400 bushels per acre.

Demands are keen, with several growers making provisions for storing. The consensus of opinion is that potatoes will be good property this coming winter. Several inquiries are being received for seed, both for local provincial requirements and for export to U. S. A.

The prices vary according to the locality, with Toronto quotations lowest across the Province at $1.60 to $1.75 per 75 pound bag, wholesale to retail, for Conada No. 1 grade. Our growers are asking $1.75 to $2.25, according to variety and locality, for Foundation A grade seed at the farm or local shipping point. (Oct. 8).

ANNUAL MEETING
POTATO ASSOCIATION OF AMERICA
HEADQUARTERS AT PALMER HOUSE, CHICAGO, ILL.
DECEMBER 28 - 31

Secretary — Reiner Bonde

The following committees have been appointed:

Registration—Harry A. Reiley
Honorary Members—Frank E. Garrett
Certification Committee — Henry M. Darling
Potato Research—E. V. Hardenburg, *Chairman*
Potato Breeding—G. H. Rieman, *Chairman*
Harvest, Transportation & Storage—J. M. Lutz, *Chairman*
Fertilizer & Culture — John Bushnell, *Chairman*
Virus & Bacterial Diseases—Jas. H. Jensen, *Chairman*
Insect Problems—Roscoe E. Hill, *Chairman*

The tentative program follows:

Sunday, December 28

9:00 A. M., Potato Association—Private Dining Room 9
1:30 P. M., Potato Association—Private Dining Room 9

Monday, December 29

9:00 A. M., Potato Association—Private Dining Room 9
1:30 P. M., Potato Association—Private Dining Room 9
7:30 P. M., Potato Association—Private Dining Room 18

Tuesday, December 30

*9:00 A. M., Joint session with American Phytopathological Society—Private Dining Room 1. O. D. Burke, *Chairman*
1:30 P. M., Potato Association—Private Dining Room 9

Wednesday, December 31

9:00 A. M., Joint session with American Society for Horticultural Science—Private Dining Room 17.

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*The joint session with the American Phytopathological Society will be held at the Stevens Hotel. All others at the Palmer House.

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STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Of American Potato Journal, published monthly at New Brunswick, New Jersey, for Sept. 23, 1947.

State of New Jersey
County of Middlesex ss

Before me, a Notary Public in and for the state and county aforesaid, personally appeared W. H. Martin, who having been duly sworn according to the law, deposes and says that he is the Editor of the American Potato Journal and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411. Postal Laws and Regulations, printed on the reverse of this form, to-wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers, are:

Publisher—Potato Association of America, New Brunswick, New Jersey.
Editor—W. H. Martin, New Brunswick, New Jersey.
Business Manager—W. H. Martin, New Brunswick, New Jersey.

2. That the owner is: (If owned by a corporation its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given).

Potato Association of America, New Brunswick, New Jersey.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state). None

4. That the two paragraphs next above, giving the names of the owners, stockholders and security holders, if any contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholders or security holders appear upon the books of the company as a trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities, in a capacity other than that of a *bona fide* owner and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is—(This information is required from daily publications only).

W. H. MARTIN, Editor.

Sworn to and subscribed before me this 23d day of September, 1947.
R. E. Long, Notary Public, Middlesex County, New Jersey.
(My Commission Expires January 31, 1949).
Form 3526—Ed. 1924.

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- **Thorough penetration of foliage.**
- **Accurate boom control.**
- **Efficient, low-cost operation.**
- **Easy lubrication and maintenance.**
- **Years of reliable service.**

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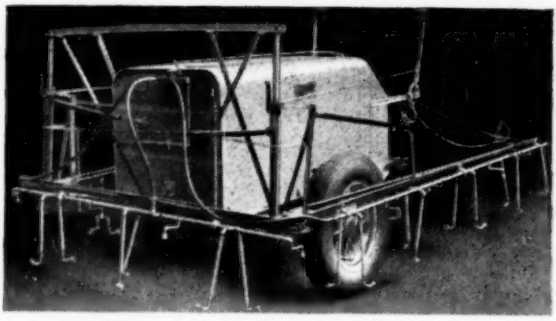
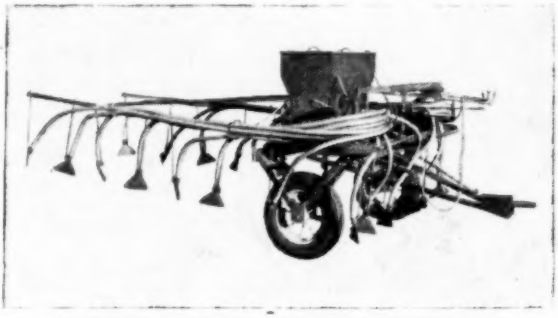


FARQUHAR IRON AGE YORK, PA. ROW CROP SPRAYERS

Model No. 71-55-01

FAMOUS IRON AGE PUMP delivers 6 to 50 gals. per minute at pressures up to 600 lbs. Eight pump sizes. **IMPROVED FOLDING BOOM** eliminates complicated control devices. Simple, rugged, easy to operate. Available in 3 to 16 row sizes; 2 to 6 nozzles per row.



FARQUHAR IRON AGE YORK, PA. ROW CROP DUSTERS

Model No. PT-1000

HIGH VELOCITY BLOWER is precision built for easy running and accurate dust feed at normal speed of 3700 R.P.M.

HANDY INDIVIDUAL LEVERS permit control of boom sections from tractor seat, eliminating plant damage due to nozzle drag.

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